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#6
5 Apr 01
R. Talbot

INTELLECTUAL PROPERTY
OFFICE OF NEW ZEALAND
Te Pou Rāhui Hanga Hou

In the matter of the Patents Act 1953 and the Regulations thereunder

AND

In the matter of an application for Letters Patent numbered 329817 in the name of POWER BEAT INTERNATIONAL.

NZ 98/98

CERTIFICATE

I hereby certify that the annexed is a true copy of the Provisional Specification as filed on 20 February 1998 with an application for Letters Patent numbered 329817 made by POWER BEAT INTERNATIONAL.

This certificate is issued in support of an application for Patent registration in a country outside New Zealand.

AS WITNESS MY HAND this 14th day of July 1998.

Neville Harris
Commissioner of Patents

PRIORITY DOCUMENT

SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

PATENTS FORM NO. 4

Appln Fee: $80.00

James & Wells Ref: 14158/16 GMP

PATENTS ACT 1953

PROVISIONAL SPECIFICATION

A DISPLAY

I, POWER BEAT INTERNATIONAL LIMITED, a New Zealand company of Devine Road, R D 3, Hamilton, New Zealand do hereby declare this invention to be described in the following statement:

A DISPLAY

TECHNICAL FIELD

This invention relates to improvements in displays.

BACKGROUND ART

Cathode ray tubes are in widespread use as television screens, computer screens and monitors of all kinds.

Recently plasma screens have been developed, which improve on cathode ray tube displays in that they reduce the volume occupied by the screen and associated circuitry.

Another method of presenting a display is by projecting an image onto a white screen via a projector. This method of display is extremely versatile as a large image may be created on any convenient white surface.

However, none of the display technology listed above provides any real feeling of depth to an observer, only allowing a two dimensional image to be displayed. These devices give no perception of depth to a viewer, and in some instances the image displayed may appear flat and lifeless.

Previously some attempts have been made to develop displays which give a perception of three-dimensional images to a viewer. This technology involves placing coloured or polarised lenses in front of an observer's eyes and projecting or displaying images on a screen. The images displayed consist of two separate, similar images superimposed upon one another, with each image being formed from one of the colours of the lenses, or from light polarised in the same direction as one of the polarised lenses.

In practice an observer may experience a three dimensional depth effect using this method of display, as their eyes experience a displacement between each superimposed

image, with each eye only seeing one of the images as the other is obscured by the relevant lens.

However, this three dimensional imaging technology has not been successful. The equipment required to record or form the original images can be expensive, and must also be added to the cost of producing lenses for each observer.

If coloured lenses are used in the above display system the lenses may limit the range of colour perception experienced by an observer. In addition, lenses formed into glasses for an observer may discomfort and annoy the observer over time, or cause problems to an observer who already wears eyesight-correcting lenses.

Liquid crystal display screens have also become very popular as display screens. However, LCDs suffer from viewing angle problems. If an observer of the display is not within approximately 70° of the centre of the screen, the image will not be well resolved. This may be contrasted with cathode ray tubes where the image displayed may be observed through an entire 180° hemisphere around the sides of the screen.

LCDs also operate using two polarising layers between an observer and the displays backlighting. An observer will see images constructed from polarised light – which significantly reduces the intensity of light emitted by the display. Relatively powerful backlighting is required for typical LCDs to ensure a sufficiently bright image is provided.

A display screen which solved the problems associated with the prior art would be of great advantage.

Specifically a screen which may provide an observer with a depth of field perception to the image displayed without requiring an observer to wear special lenses would be of great advantage over the prior art.

It is an object of the present invention to address the foregoing problems or at least to

provide the public with a useful choice.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only.

DISCLOSURE OF INVENTION

According to one aspect of the present invention there is provided a display including at least two screens wherein both screens are capable of displaying images, and at least one screen is at least partially transparent to an image displayed on another screen,

the display being characterised in that the partially transparent screen is placed in front of the other screen to form a composite image.

According to another aspect of the present invention there is provided a method of forming a composite image using a display as described above, characterised by the steps of;

a) displaying a first image on a first screen, and

b) displaying a second image on a second at least partially transparent screen positioned in front of the first screen.

In a preferred embodiment of the present invention the display may be configured as any device used to display information of any type to an observer.

In a further preferred embodiment the display may be configured to allow moving images or information to be displayed to an observer. This feature of the invention allows the display to be used in any number of applications where an eye catching or informative display is required.

In a preferred embodiment the display is configured to display video images. The display may be used in home video and television equipment as a computer screen

monitor, in large scale movie theatre projection set ups or in video games machines which interface with either a television or a stand alone games unit.

Alternative embodiments may not employ the display in video applications only. For example, the display may be used in information presentation applications such as computer control screens. The display may be configured to show images relating to, for example, an actual piece of information compared with a planned or budgeted target for the actual value.

In further alternative embodiments the display may be applied to further applications, for example being full motion advertising billboards which catch the eye of observers, special effects video technology, or cartoon cell overlays used in the production of cartoon video footage.

In yet further embodiments the display may be employed to display still images only. Such a display may be constructed from relatively cheap low technology materials and components, to present a static composite image which is eye catching and gives an illusion of depth or a three-dimensional depth effect. Such a composite still image may be very useful in advertising applications, providing a low cost display which is eye catching and dramatic.

In a preferred embodiment the screens used may be liquid crystal displays. Liquid crystal displays allow images or information to be displayed in colour at relatively high resolutions. The information or images displayed on a liquid crystal display (LCD) may be manipulated, processed or sourced using well-known computer technology.

Further, LCDs have a transparent base material through which other screens can be viewed.

Alternative embodiments may not employ LCDs as the screens used. For example, in

other embodiments cathode ray tubes, plasma screens or projection screens or combinations of these may be used in conjunction with the invention.

In an additional alternative embodiment of the present invention, there may also be a magnifying lens associated with a screen. Such magnifying lenses may give the impression of a larger screen or picture to an observer, without the associated material costs of producing a larger display.

Reference throughout this specification shall now be made to the screens used as being liquid crystal displays. However, it should be appreciated by those skilled in the art that other types of screens may be used in conjunction with the invention, not necessarily being liquid crystal displays.

In a further preferred embodiment of the present invention the display employs two screens only. This configuration of the invention still allows the display to form a composite image, yet reduces the manufacturing costs of the display as only two screens are required to implement the invention.

However, it should be appreciated by those skilled in the art that other embodiments may not employ only two screens. For example, any number of screens may be used in conjunction with the present invention, depending on the applications to which the display is to be put.

In a further preferred embodiment where two screens only are used in the display, one of the screens used may be an active colour matrix LCD which is back-lit from the rear. Such a screen may be used to present the first in a series of images to construct a composite image. The screen backlighting may help the images produced to stand out clearly.

In a preferred embodiment the images presented by the display may be any type of image which is required for the specific application to which the display is being used.

For example, if the display is employed as a television screen, the images presented may be video footage of a sports match, or an entertainment movie. Alternatively, if the display is employed as a computer monitor the images displayed may be text or number strings or computer graphics.

In a preferred embodiment of the present invention at least one screen is provided in the display which is partially or fully transparent. Such a transparent screen allows an image displayed from a screen behind the transparent screen to be viewed by an observer through the transparent screen.

In a further preferred embodiment a substantially transparent screen used in the display may be constructed from an existing liquid crystal display. A transparent liquid crystal display (TLC display) may be formed from an existing LC display which does not include any components to the rear or the screen which can stop light transmission. A TLC display may be a normal LC display without the usually rearward backlighting components normally used.

Such screens may be controlled or provided with image data using well known techniques, and allow an image from a rearward screen to be viewed by an observer through the TLC display. In addition, a TLC display used as described above would not include backlighting from the rear of the display, as this may prevent an observer from viewing images prescribed on a rearward screen. Such a screen may however utilise light projected from a screen at its rear to highlight the images it displays.

In one embodiment of the present invention any substantially transparent screen used in the display may be lit from the sides of the display. Lighting the screen from its sides, as opposed to its rear still allows the image on the screen to be highlighted, yet does not interfere with any subsequent images projected from behind the transparent screen. However, it should be appreciated by those skilled in the art that the display may be configured with or without any type of lighting as required by the application

in which the screen is to be employed.

In a further preferred embodiment the display is configured with two screens, the first rearward screen being a standard back-lit LC display, and the second front screen being a TLC display. This configuration of the invention allows both screens of the display to be easily controlled and provided with electrical power, possibly by the same circuitry.

In a preferred embodiment the two screens employed in the display may be configured so that the TLC display is placed directly in front of the LC display, effectively allowing an observer to watch the LC display easily through the TLC display when the TLC display is inactive.

Reference throughout this specification shall now be made to the display as being configured with a back-lit LC display in its rear, and a TLC display in its front. However, it should be appreciated by those skilled in the art that the display may be implemented in other embodiments using different configurations and types of screens, not necessarily being two LC displays as described above.

In a preferred embodiment of the present invention a composite image may be formed by the combination of images displayed on each screen when viewed by an observer positioned in front of the display (and hence both screens).

Such composite images give the illusion of depth to an observer, as there is a displacement between the two screens displaying portions of the composite image. For example, in one embodiment the LC display may present an image of the background of a scene from a video recording while the front TLC display may present the foreground of the same video recording.

Alternatively both screens may display the same image, but with the front TLC displaying only selected portions of the image compared with that displayed on the

rear LC display. The LC display may contain the entire image while the TLC display shows the foreground images only.

Such a display may be used to create a perception of depth in the images observed. An image present only on the back LC display may be magnified on this display and then transferred onto the front TLC display. This technique gives the illusion that the image is bursting out of the display. Conversely, the reverse effect can be used to give the impression that the image is receding away from the observer.

In preferred embodiments of the present invention where two or more LCD screens are used, interference patterns may be observed by a display's observer caused by the colour filters used on each screen. In one embodiment this interference problem may be eliminated by using different colour filter patterns on each subsequent screen.

A rearward screen may configured with a high-resolution delta colour filter and a following forward screen be may be configured with a low-resolution stripe configuration colour filter.

According to a further aspect of the present invention there is provided a display including a diffuser, and

at least two screens

wherein both screens are capable of displaying images, and

at least one screen is at least partially transparent to an image displayed on another screen,

the display being characterised in that the partially transparent screen is placed in front of the other screen to form a composite image, and

the diffuser is placed between the partially transparent screen and any other screen used.

In a preferred embodiment the diffuser may be any element capable of diffusing or randomising light which passes through the diffuser.

In a further preferred embodiment the diffuser used may be a surface with a randomised structure applied to the rear of a front screen. Such a structure or surface may cause light to be diffused when it travels through the diffuser.

Alternative embodiments of the present invention may not employ a diffuser formed on the rear surface of a front screen. For example, in alternative embodiments separate elements such as a lightly frosted glass panel or any clear plastic material with a randomly abraded surface may be used as the diffuser. Alternatively, any element which may act to diffuse light passing through it may be used as a diffuser.

Placing the diffuser between the front and back screens prevents interference patterns being viewed by an observer of the display.

The diffuser acts to randomise or break up any interference patterns caused by the regular structure of elements within the screens used. A low level of diffusion from the diffuser will remove any interference patterns normally viewed by the observer without substantially degrading the quality or sharpness of any image present on a rear screen.

Accordingly to another aspect of the present invention there is provided a display including

at least two screens wherein both screens are capable of displaying images, and

at least one screen is at least partially transparent to an image displayed on another screen, and

a diffuser,

the display being characterised in that the partially transparent screen is placed in front

of the other screen to form a composite image, and

the diffuser is placed in front of the transparent screen.

Placing the diffuser in front of the front screen increases the display viewing angles. Light transmitted through the front screen is dispersed over a larger number of angles than normal, increasing the viewing angle of the display for an observer.

According to a further aspect of the present invention there is provided a display including at least one screen capable of displaying images, and

a diffuser,

the display being characterised in that the diffuser is placed in front of the screen to diffuse light emitted from said screen.

In such an embodiment a diffuser may be sold as an "after market" product which can be added on to existing liquid crystal displays. In such an embodiment the diffuser may act to diffuse light from the screen enough to increase the screens viewing angle yet still keep the images displayed relatively sharp. The diffuser may be configured to clip on to or attach to standard size liquid crystal display screens.

In a preferred embodiment of the present invention the distance between the screens employed in the display may be approximately three centimetres. The physical displacement of the screens from one another provides the composite images displayed with three dimensional depth, as images on the front screen are displayed closer to an observer than images on the rear screen of the display.

However, reference to the distance between the display screens being three centimetres should in no way be seen as limiting. Those skilled in the art should realise that any particular value of displacement between the displaced screens may be used in conjunction with the invention.

In an alternative embodiment of the present invention the screens of the display may be configured to allow movement of one screen relative to another. This again may give the illusion of depth to an observer if they see an image on the rear screen of the display slowly moving closer towards them, as the rear screen moves forward relative to a front screen.

According to a further aspect of the present invention there is provided a display including

a refractor, and

at least two screens wherein both screens are capable of displaying images, and

at least one screen is at least partially transparent to an image displayed on another screen,

the display being characterised in that the partially transparent screen is placed in front of the other screen to form a composite image and a refractor refracts a substantial portion of an image from a rear screen onto a front screen.

In preferred embodiments a refractor is placed between two screens employed in the present invention. The refractor acts to bend light from the edges of the rear screen around to the edges of a front screen, improving image quality for an observer who views the display from a wide angle.

Normally when an observer views a display from a wide angle the observer can see the edge of a rear screen. Light provided from the rear screen is cut off from an observer out at a wide angle to the centre of the display. At a wide observation angle light from a rear screen used to illuminate an image on a front screen is cut-off, reducing the size of images seen on the front and rear screens. For this reason a rear screen is preferably larger than a front screen - but will still suffer from the above problems without the use of a refractor.

A refractor may in a preferred embodiment be constructed from any material which may refract light. For example, in a preferred embodiment a piece of transparent plastic may be used as a refractor, where the refractive index of the plastic is greater than that of air. This property of the refractor bends light which would be normally missed at the far edges of the rear screen to an angle so that an observer sitting to one side can not see the edges of the screen.

Alternative embodiments of the present invention may not employ a piece of transparent plastic as the refractor. For example, in one alternative embodiment a lens may be used as a refractor. Such a lens may be mounted on either the front of a rear screen or the rear of a front screen.

In a further preferred embodiment where transparent plastic forms the refractor, a refractor may be constructed from clear plastics materials in a substantially square shape with mitred edges. In such an embodiment the edges of the refractor block may be mitred so that the far edges of the refractor are in contact to the far edges of each screen.

In a further alternative embodiment a refractor may be constructed from a mitred sheet of transparent plastic material wherein the mitre applied to the edge of the material makes an angle of approximately 45° or greater with the larger surface of the mitred block. Mitring the block at this angle provides a materials cost saving, as just enough plastics material is incorporated into the display that is required.

In a preferred embodiment the substantial portion of an image refracted from a rear screen onto a front screen may be the entire image displayed on the rear screen. However, it should be appreciated by these skilled in the art that a refractor may be configured to refract as much of a rear screen image as required in any particular application.

In a preferred embodiment of the present invention the display may be configured as a

television which is capable of receiving a number of separate frequency broadcasted signals which can be integrated into a signal composite image displayed by the television. Such a television may receive the information or images required to be displayed on each screen on a separate frequency channel broadcast by a television station.

In addition, separate sets of camera recording teams may be used to record images which could be displayed on such televisions. For example, one camera team could record the images to be presented in the foreground of a composite image, while another team records images to be displayed in the background of a composite image.

However, alternative embodiments may not employ displays which receive separate signals for each image to be displayed on each screen of the device.

For example, in some embodiments a display may receive a single signal with all the information required for display on each of its screens. A display configured in such a manner may include a central control component which analyses, filters and processes the single information signal and retransmits the relevant information to each screen of the display.

Alternatively the single signal could be fed into each screen of the device-with each screen completing its own filtering processing and displaying functions dependent on its position in the display.

In a preferred embodiment of the present invention the display includes a central control device. This control device may receive all the relevant signals required to form a composite image on the display, routing the required signals to the first rear screen, followed by further signals routed to subsequent forward screens.

In a further alternative embodiment of the present invention a television broadcaster may broadcast a number of views as recorded by each camera at a location. Using the

display as described above an observer may pick and choose or "mix" the display they wish to observe from the several camera angles supplied. For example, an observer may wish to focus particularly on one player only during a sporting match, and hence tailor the images presented on their display to show mostly views of that player only.

In an alternative embodiment, where a standard video or television signal is applied to the display there may be provided associated software and hardware with the display which may process the single signal into the relevant inputs for each screen of the display. Software algorithms may be used which take a standard video signal and extract the background images from the foreground images. Software algorithms may work, for example, by observing the rate of change of pixels in a display to determine whether a pixel should be in the foreground or the background, or look at the number of pixels changing at specific rates and place the largest numbers of pixels with the same rate of change in the background.

The present invention holds several advantages over prior art display devices.

A display as described above gives the images displayed a sense of depth and reality so far not experienced with conventional video technology. For example, an observer may perceive that an object is speeding towards them as it progresses from a rear screen to a front screen.

The display may be implemented using conventional well-known liquid crystal display technology at a reasonable cost. The display may also be manufactured and maintained by qualified service persons relatively easily.

The display allows an observer to customise the view they wish to see, placing a number of camera angles on each screen of the display. The display has a wide ranging number of applications, from conventional video display technology to information control displays, to active full motion billboard advertising.

BRIEF DESCRIPTION OF DRAWINGS

Further aspects of the present invention will become apparent from the following description which is given by way of example only and with reference to the accompanying drawing in which:

Figure 1 illustrates a display as configured in one embodiment of the present invention,

Figure 2 illustrates interference patterns normally observed when two LC displays are combined together, and the view obtained with respect to one embodiment of the present invention,

Figure 3 illustrates viewing angles for a conventional LC display and viewing angles experienced in another embodiment of the present invention,

Figure 4 illustrates displays formed using two screens, one without a refractor and one including a refractor.

Figure 5 illustrates two conventional LC displays with one display including a diffuser.

BEST MODES FOR CARRYING OUT THE INVENTION

Figure 1 illustrates a display as shown by a video monitor 1. The monitor 1 includes control circuitry 2, a rear screen 3, and a front screen 4.

Associated with each screen 3 and 4 is a control cable 5 which carries control signals to a screen from the control circuitry 2. The control cable 5 may provide electrical power as well as control instructions to each screen, allowing the required image to be formed on each screen of the monitor 1.

Displayed on the back screen 3 is a background image 6. Displayed on the front screen 4 is a foreground image 7.

In use, an observer may position themselves directly in front of both the front screen 4 and back screen 3 so they observe a composite image on the monitor 1 formed by the background image 6 and the foreground image 7.

If a portion of the background image 6 is to become part of the foreground, the control cable 5 may instruct the front screen 4 to display the required image in the foreground image 7, giving an observer the perception that the associated image is moving forward towards them.

Figure 2 shows two views of a display formed using two LC displays.

Figure 2a shows a display without a diffuser. As can be seen from the diagram an observer will notice interference patterns 1 present where the rear screen 2 is viewed through the front screen 3.

Figure 2b illustrates a display which incorporates a rear screen 4 a diffuser 5 and a front screen 6. As can be seen from Figure 2b the interference patterns 1 previously present are now removed by the diffuser 5. The regular patterning created in light transmitted through the rear screen 4 is broken up and dispersed by the disperser 5 before it reaches the front screen 6, preventing interference patterns being formed and seen by an observer.

Figure 3 illustrates viewing angles for a conventional LC display and viewing angles experienced in one embodiment of the invention.

Figure 3a shows a standard LC display 1, as well as the upper viewing angle limit 2 and lower viewing angle limit 3a for the display. As can be seen from Figure 3 any observer elevated or depressed greater than 25 ° from the centre of the screen 1 will not

clearly be able to see any images formed on the screen 1.

This may be contrasted with the viewing angles of one embodiment of the present invention, as shown in Figure 3b. The observer of a display 4 may be elevated or depressed upwards of 90° from the centre of the display 4 without observing any degradation in the image displayed on the screen 4.

Figure 4 illustrates two types of display, one without a refractor and one including a refractor.

Figure 4a shows a display formed without a refractor. As can be seen from the diagram an observer out at a wide angle from the centre of the display will be able to see very little of the front screen, and will also see the edges of the rear screen.

Figure 4b shows a display which includes a refractor 1. An observer positioned at a wide angle from the centre of the display is now able to observe a greater portion of the image displayed on the front screen and now cannot see the edges of the rear screen due to the action of the refractor bending light towards the observer.

Figure 5 shows two standard liquid crystal displays. Each display includes a first polariser P1 two retainer layers 2 and a second polariser 3. The LC display shown in Figure 5b also includes a diffuser 4 positioned next to the final polariser 3.

In use unpolarised light 5 is transmitted through the first polariser 1 forming polarised light 6. This polarised light 6 is then transmitted through liquid crystals (not shown) retained in each of the retainer layers 2. The liquid crystals form twisted light 7 from incident polarised light 6. This twisted light 7 is then transmitted through the last polariser 3.

The diffuser shown in Figure 5b acts to diffuse the twisted polarised light 7 out of a large number of angles, thereby increasing the viewing angle for the display.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof.

POWER BEAT INTERNATIONAL LIMITED

by its Attorneys

JAMES & WELLS

FIG. 1

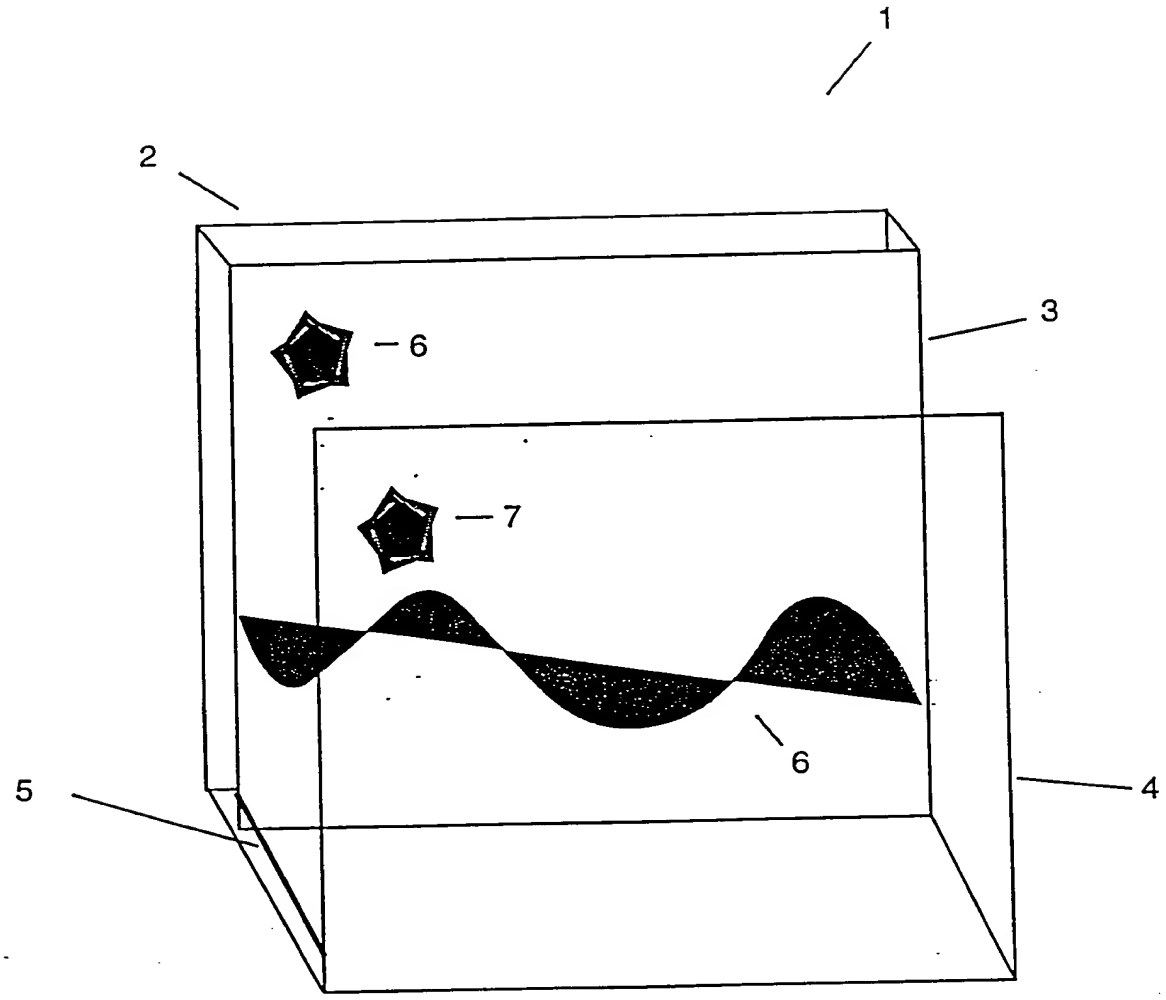

Figure 2a

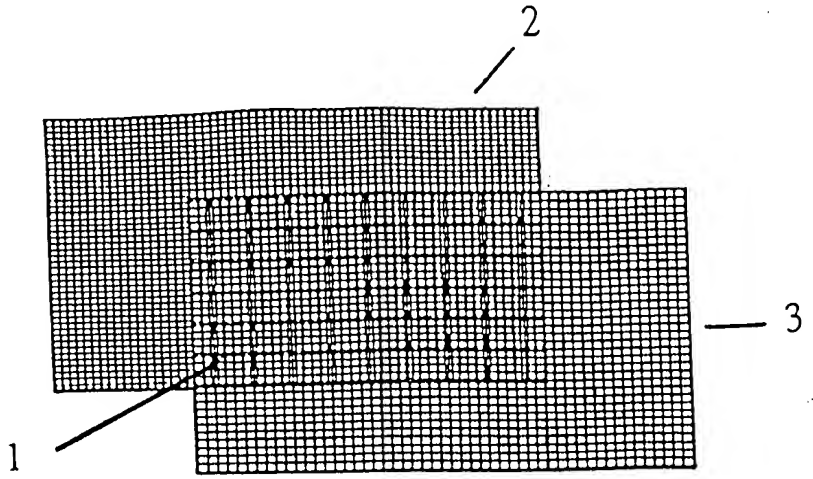

Figure 2b

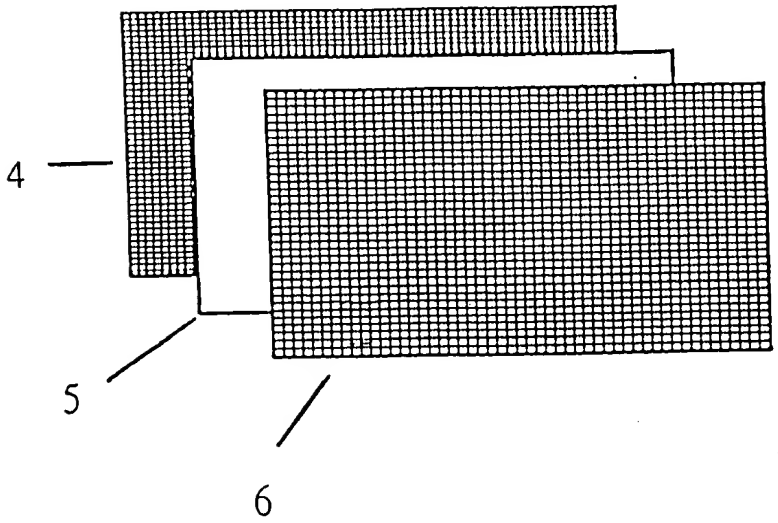

Figure 3a

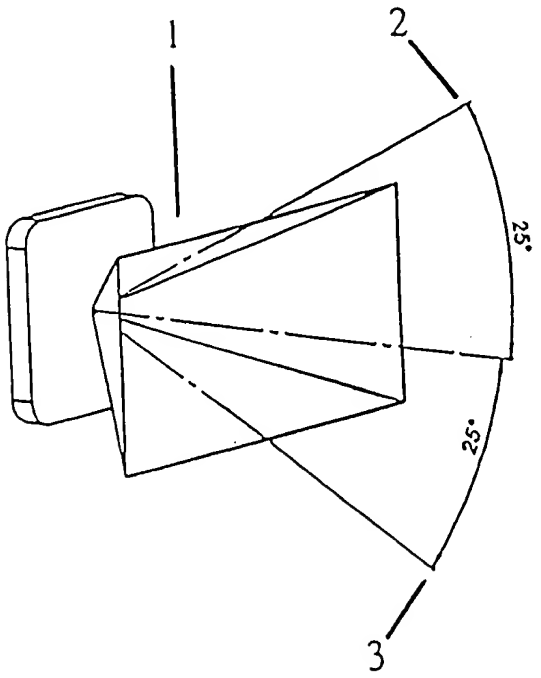

Figure 3b

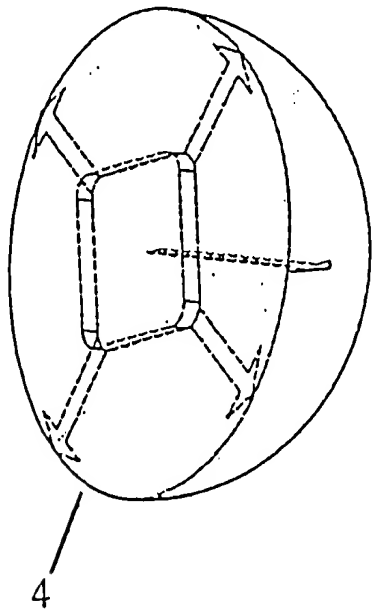

Figure 4a

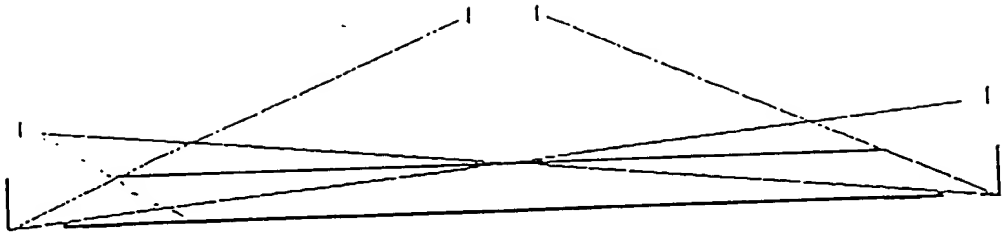

Figure 4b

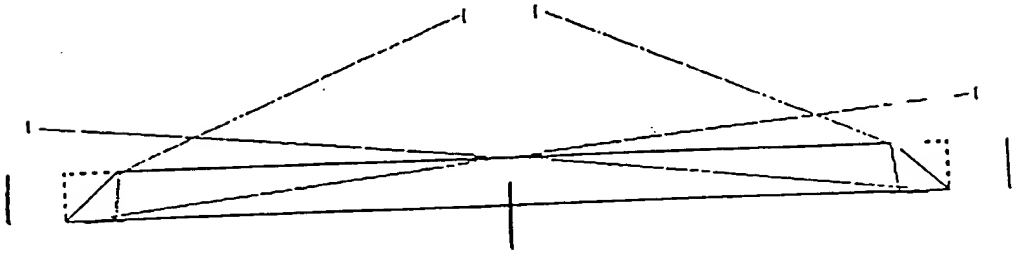

Figure 5a

Figure 5b